

RELATIONSHIP BETWEEN STEAMING UP WITH COLOSTRUM PRODUCTION AT DIFFERENT MILKING TIMES IN HOLSTEIN-FRIESIAN COWS

Puguh SURJOWARDOJO¹✉, Primasatya NUGRAHA¹, RIFA'I², Hanum MUARIFAH¹, and Aditya Cahya WARDHANA¹

¹Faculty of Animal Science, Universitas Brawijaya, Jl. Veteran, Malang, 6541, Indonesia.

²Faculty of Animal Science, University of Kahuripan Kediri, Jl. PB Sudirman No. 27, Kediri, 64212, Indonesia

✉Email: puguhsurjowardojo@ub.ac.id

Supporting Information

ABSTRACT: Aims of study was to determine the relationship between steaming up with colostrum production at different milking times. The animals used in this research were 36 pregnant Holstein-Friesian (HF) cows. The method used in this research was a case study. Samples were determined with purposive sampling. The selected animal was divided into two groups, T₁ (control) and T₂ (steaming up). The steaming up was done two weeks prior to calving. The total average of colostrum production from HF cows that were in T₂ group was 11.96±2.40 liter/cow/day, while the mean value of colostrum production from HF cows that were in T₁ group was 8.05±1.80 liter/cow/day. The average colostrum production that was collected at morning milking from cows in T₂ group was 6.38±1.36 liter/cow/day and at afternoon milking was 5.58±1.11 liter/cow/day, significantly higher than T₁ group which was 4.22±0.92 liter/cow/day at morning milking and 3.83±0.90 liter/cow/day. The result of the regression equation on morning milking is $Y = 2.059 + 2.159x$. This means that steaming up treatment can increase colostrum production by as much as 2.159 liters at morning milking. While the result of the regression equation on afternoon milking is $Y = 1.753 + 2.078x$. This means steaming up treatment can escalate the colostrum production as much as 2.078 at afternoon milking. That equation is used as the basis for estimating the relationship between steaming up with colostrum production at both milking times, with a correlation coefficient (*r*) between steaming up and colostrum quantity at morning milking is 0.692, which means the relationship is in the strong category. Meanwhile, the relationship between steaming up and colostrum yield at afternoon milking is 0.666, which means the relationship is also in the strong category. It was concluded that steaming up had a very significant effect at both milking times in Holstein-Friesian cows.

Keywords: Calving, Colostrum production, Holstein-Friesian Cows, Milking time, Steaming up.

INTRODUCTION

In general terms, dairy cows make a major contribution to the national milk needs for human nutrition (Graulet, 2014). There are two most common dairy cow breeds in Indonesia, which are Holstein-Friesian (HF) and Jersey, whilst HF has the highest milk production than any other breed that can reach 4500-5000 liter in one lactation period (305 days) (Sembada, 2018). Milk production in Indonesia is relatively low, with production in 2022 as much as 968.980,14 tons (Statistics Indonesia, 2023). Dairy milk production depends on various factors such as the genetic, environmental, genetic, and environmental interaction, how milking increases milk production and milking interval (Beerda et al., 2007; Abdelsayed et al., 2014; Garantjang et al., 2020). Many local farmers are looking for a way to increase their cow's milk production (Kant and Yadav, 2016). One of the ways is steaming up treatment for cross-bred cattle (Sirohi et al., 2014; Kant and Yadav, 2016).

Steaming up or extra feeding of nutrients helps enhance the cow's milk production (Das et al., 2007). Steaming up was conducted during a dry period, approximately 2-3 weeks before calving (Arfuso et al., 2016). The purpose of steaming up is to give better production performance of the dairy cow in the next lactation period because it allows the udder secretory cells to develop maximally before the start of the lactation period (Nugraha and Surjowardojo, 2022). High-energy feeding consumption during late gestation will high-energy feed consumption required during late gestation ensures adequate nutrient supply and produce good growth of the mother and fetus (Dharmawan et al., 2019). Feeding extra nutrients to cows before calving is claimed to increase milk production and make cows ready for high intakes of concentrates that should be fed in early lactation (Pradhan et al., 2011). Moreover, increasing the quantity and quality of the feed is an effort to counteract NEB (Negative Energy Balance) (Bünemann et al., 2020). Cows are unable to adapt to

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the metabolic demands during the pre- and post-partum transition period and are more prone to subsequent negative events (Fiore et al., 2017). In addition, steaming up also has a role in bovine colostrum production, which is important to maintain dairy cow production performance (Surjowardojo et al., 2021).

Colostrum is the first milk that comes out from the udder after calving, which contains antibodies and nutrition for the calf (Surjowardojo et al., 2021) and it is produced for the next five days (Quinn et al., 2020). Colostrum has a yellowish color with a thick texture that is given to the calf as long as the colostrum still produce and has not transitioned into fresh milk (Surjowardojo et al., 2022). Colostrum has unreplaceable contents such as macro- and micro-nutrient, immunoglobulins, antimicrobial peptides, and growth factors. More specifically, the defense mechanism from colostrum can counter bacteria and virus contamination (Surjowardojo et al., 2020) and it is vital for calf since a passive immune system of the calf was obtained from consuming colostrum (Susilorini et al., 2023). There is evidence that colostrum is essential for nutritional and immunological support, growth, and development of the newborn calf (Playford and Weiser, 2021). The contributing factors in colostrum production are dry period length, dry period nutrition, parity, season, and previous 305 days of milk production (Gavin et al., 2018). Nugraha and Surjowardojo (2022) in their research stated that steaming up treatment can increase the colostrum yield. Therefore, the main objective of this study was to examine the relationship between steaming up with the colostrum production at different milking times.

MATERIALS AND METHODS

The research method used in this research was a case study at Koperasi Peternakan Sapi Perah (KPSP) Setia Kawan, Nongkojajar, Tutur Sub District, Pasuruan Regency. The material used in this research was 36 HF cows, which had already entered the dry period. The samples were determined by purposive sampling. These cows were either in their 2nd or in their 3rd lactation period. The selected animals were in their late stage of pregnancy and divided into two groups, the control (T₁) group and steaming up (T₂) group. The animals in group T₁ were provided with 30 kg grass per day and 4 kg concentrate per day whilst, in group T₂ were given 35 kg grass per day and 8 kg concentrate per day, two weeks before calving. Concentrate consists of a mix of pollard, corn DDGS (Distiller Dried Grains with Soluble), wheat DDGS, CGF (Corn Gluten Feed) and PKE (Palm Kernel Expeller), which contains vitamins, minerals, and antioxidants as feed additives. Field observation was held to obtain primary data and identify colostrum production. The first colostrum was measured with a measuring container at the exact moment after the cows gave birth or no later than 30 minutes after. Afterwards, colostrum production was observed until the next five days. Morning milking was carried out at 5.00 a.m., while afternoon milking was at 3.00 p.m. Colostrum production from both treatment groups was analyzed statistically by linear regression. Statistical analysis was conducted using Microsoft Excel 365 and IBM SPSS Statistics 26 software.

Ethical regulations

This study was conducted in accordance with the Animal Care and Use Committee, Universitas Brawijaya, Malang, East Java, Indonesia, with ethical clearance number 062-KEP-UB-2023.

RESULTS AND DISCUSSION

According to the data in Table 1, the total colostrum production in T₂ (steaming up) was 11.96±2.40 liter/cow/day, dramatically higher than that produced in the treatment T₁ (control) group which was 8.05±1.80 liter/cow/day. This is in accordance with (Nugraha and Surjowardojo, 2022) which stated that steaming up treatment on dairy cows that was carried out by farmers gives a better performance of colostrum production compared to cows that were not treated with the treatment. The cows in T₂ (steaming-up) group produced 6.38±1.36 liter/cow/day at morning milking and 5.53 liter/cow/day in the afternoon, which was significantly higher than that produced in the treatment T₁ (control) group which was 4.22±0.92 liter/cow/day at morning milking and 3.83±0.90 liter/cow/day in the afternoon (Jurkiewicz et al., 2005) stated that increasing the nutrient value of diets during the final week before calving and one week after will improve the milk production and the blood metabolite, as indicated by the improved protein and energy balance of periparturient cows and lower susceptibility of the cow's metabolic order. Steaming up can also have a positive effect on calf birth weight (Das et al., 2007).

Table 1 - Colostrum production at morning milking and afternoon milking

Treatment	Mean ± Std. Dev	N	Colostrum Production at Morning Milking (5.00 a.m.) (liter/cow/day)	Colostrum Production at Afternoon Milking (3.00 p.m.) (liter/cow/day)	Total Colostrum Production (liter/cow/day)
T ₁ (control) group		18	4.22±0.92 ^a	3.83±0.90 ^a	8.05±1.80 ^a
T ₂ (steaming up) group		18	6.38±1.36 ^b	5.58±1.11 ^b	11.96±2.40 ^b
Total		36	5.30±1.58	4.70±1.34	10.01±2.88

Steaming up treatment showed a very highly significant different effect (P < 0.001) on colostrum production at both milking times.

This research also showed colostrum that was collected in the morning milking had higher average production compared to colostrum production in afternoon milking on either treatment. Milk production collected at morning milking tends to be higher than that harvested at afternoon milking because the interval time for milking in the morning was longer (14 hours) than the interval time for milking in the afternoon (10 hours). Milking interval is one of the factors that affect milk quality and quantity, longer interval tends to have higher milk production (Garantjang et al., 2020).

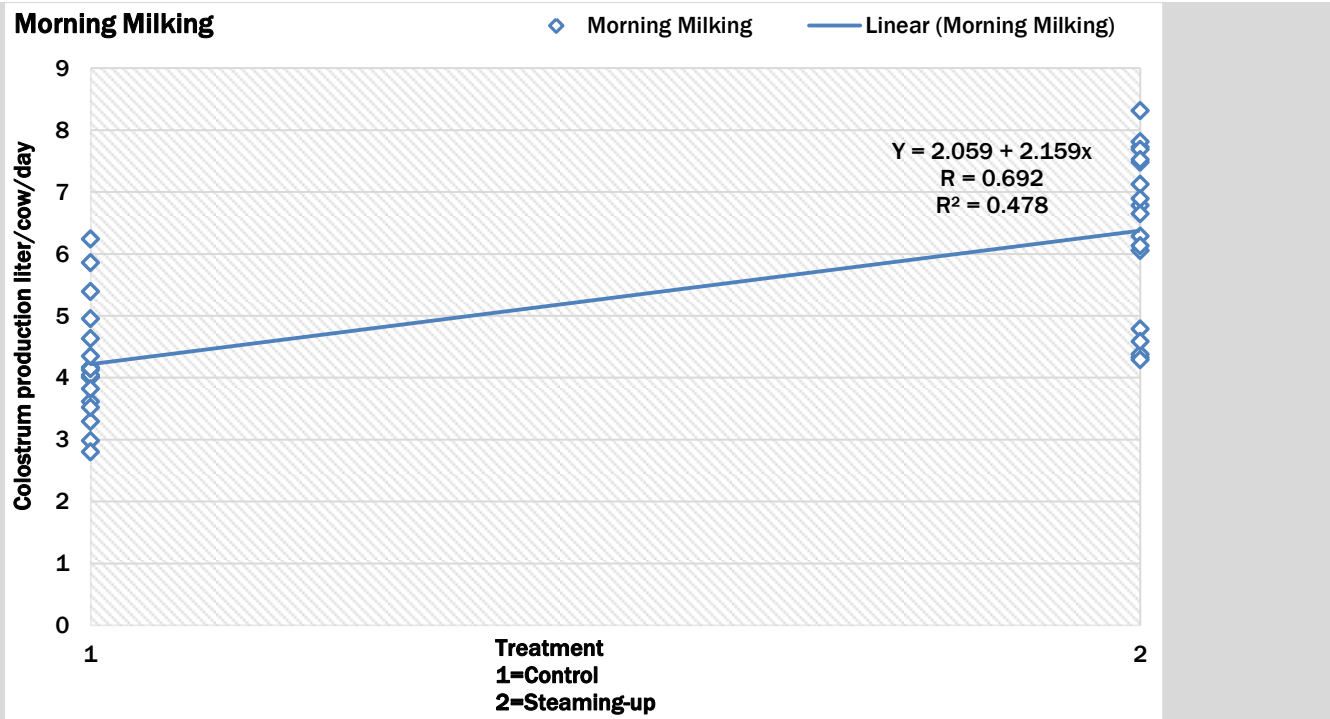


Figure 1 - Colostrum production at morning milking

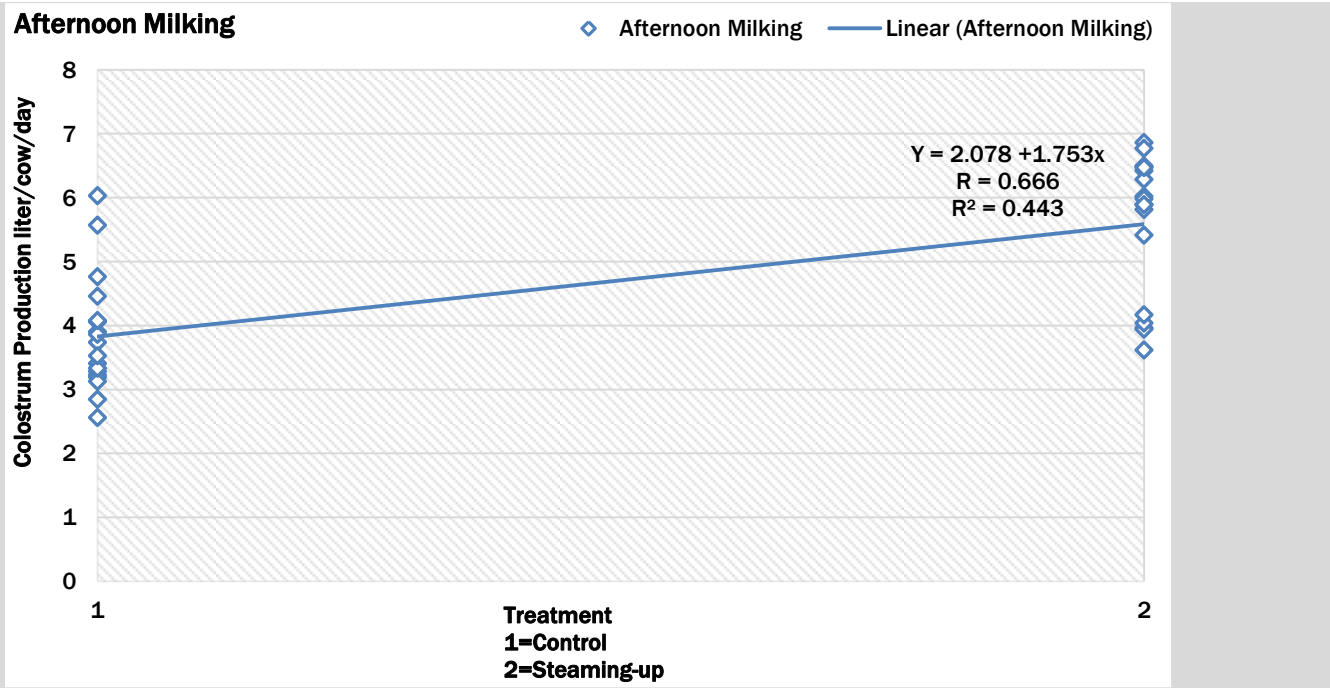


Figure 2 - Colostrum production at afternoon milking

As reported in Figure 1, the result of the regression and correlation analysis between steaming up with colostrum production at morning milking shows that the correlation coefficient (R) value is 0.692 which means both variables have a positive strong relationship. While in Figure 2, shows that the R-value of the data analysis between steaming up with colostrum production afternoon milking is 0.666 which means both variables also have a strong relationship. Figure 1 also shows that the value of the coefficient of determination (R²) is 0.478. which implies that the effect of steaming up

on colostrum production at morning milking is 47.8%. While the remaining 52.2% is influenced by other factors. Soufleri et al. (2021) stated that colostrum production is affected by several factors like lactation period, season, parity, dry period length, previous lactation milk yield, milking interval and BCS. Surjowardojo et al. (2020) also stated that harvest time can also be a factor that can be affecting colostrum production. Whilst in Figure 2 depicts that the value of the R^2 is 0.443 which means that steaming up treatment affects 44.3% of the colostrum production at afternoon milking and the remaining 55.7% is determined by other factors.

Moreover, in Figure 1, the result of regression and correlation analysis shows that the value of the regression is $Y = 2.059 + 2.159x$. It means that excessive feeding both in quality and quantity before calving can increase the colostrum yield at morning milking as big as 2.159 liter/cow/day. Kant and Yadav (2016) in their research stated that cows that were fed with 4 kg of concentrate at each meal had higher colostrum production and milk production compared to cows that were fed with 2 kg of concentrate. Colostrum production experienced a peak in the production when the cows were in their 3rd lactation period and age at first gestation also affects the amount of colostrum production (Putri and Surjowardojo, 2022). Meanwhile, in Figure 2, the value of the regression is $Y = 2,078 + 1.753x$. This implies that steaming up treatment performed on HF cows could escalate the production of colostrum at afternoon milking as much as 1.753 liter/cow/day. According to Surjowardojo et al. (2022) the quality of the colostrum that is harvested in the afternoon is higher, but the colostrum production is lower. It is caused by the increasing temperature in the afternoon which affects cow physiology. On the other hand, colostrum production that is collected in the morning has a higher production, yet the quality is lesser.

CONCLUSION

Steaming up treatment had a strong relationship with production colostrum and had a very highly significant effect ($P < 0.001$) on colostrum production in both milking times (morning and afternoon) on Holstein-Friesian cows. It suggested that farmer need to carry out steaming up treatment to their HF cows because it has been proven to have a positive effect on colostrum production in both morning and afternoon milking which are suitable for fulfilling the calf need and bodes well for milk production in the next lactation.

DECLARATIONS

Corresponding author

E-mail: puguhsurjowardojo@ub.ac.id

Authors' contribution

P. Surjowardojo and P. Nugraha designed the study and manuscript writing. Rifa'i and A. C. Wardhana Collecting samples and data. H. Muarifah analysis data and manuscript writing. All authors drafted and revised the manuscript as read, evaluation and approved the final manuscript.

Conflict of interests

The authors have not declared any conflict of interests.

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REFERENCES

- Abdelsayed M, Thomson PC, and Raadsma HW (2014). A review of the genetic and non-genetic factors affecting extended lactation in pasture-based dairy systems. *Animal Production Science*, 55(8): 949-966. <https://doi.org/10.1071/AN13300>
- Arfuso F, Fazio F, Panzera M, Gianneto C, Di Pietro S, Giudice E and Piccione G (2017). Lipid and lipoprotein profile changes in newborn calves in response to the perinatal period. *Acta Veterinaria-Beograd*, 67(1):25-32. <https://doi.org/10.5194/aab-59-429-201>
- Beerda B, Ouweltjes W, Šebek LB, Windig JJ, and Veerkamp RF (2007). Effects of genotype by environment interactions on milk yield, energy balance, and protein balance. *Journal of Dairy Science*, 90(1):219-228. [https://doi.org/10.3168/jds.S0022-0302\(07\)72623-1](https://doi.org/10.3168/jds.S0022-0302(07)72623-1)
- Bünemann K, Frahm J, Kersten S, Hüther L, Meyer U, Sauerwein H, Hummel J, Zeyner A, and Dänicke S (2020). Effects of pre-calving body condition and different post partum concentrate feed proportions on immune-associated and hematological parameters in pluriparous dairy cows. *Animals*, 10(12):1-18. <https://doi.org/10.3390/ani10122251>
- Dharmawan R, Surjowardojo P, and Susilorini TE (2019). Effect of steaming up by *gliricidia sepium* to dairy goats during dry period on goat kid growth of etawah crossbred. *Indonesian Journal of Animal Science*, 29(2): 101-108. <https://doi.org/10.21776/ub.jiip.2019.029.02.02>

- Das KS, Das N, and Ravikumar GVPP (2007). Effect of 'steaming-up' on subsequent production in dairy cows. *Indian Journal of Animal Sciences*, 77(7): 583-585. <https://epubs.icar.org.in/ejournal/index.php/IJAnS/article/view/5500>
- Fiore E, Piccione G, Arfuso F, Zumbo A, and Gianesella M (2017). Metabolic changes in dairy cows at different lactation class during the transition period. *Large Animal Review*, 23(23):45-48. https://vetjournal.it/images/archive/LAR%202017/Fiore_imp.pdf
- Garantjang S, Rusdy M, Hatta M, Nohong B, and Sema (2020). Effect of milking time on milk production and milk quality of dairy cow fed with fermented corn cob. *IOP Conference Series: Earth and Environmental Science*, 492: 012054 <https://doi.org/10.1088/1755-1315/492/1/012054>
- Gavin K, Neibergs H, Hoffman A, Kiser JN, Cornmesser MA, Haredasht SA, et al. (2018). Low colostrum yield in jersey cattle and potential risk factors. *Journal of Dairy Science*, 101(7):6388-6398. <https://doi.org/10.3168/jds.2017-14308>
- Graulet B (2014). Ruminant milk: A source of vitamins in human nutrition. *Animal Frontiers*, 4(2):24-30. <https://doi.org/10.2527/af.2014-0011>
- Jurkiewicz, A, Strzetelski JA, Kowalczyk J, and Bilik K (2005). Concentrate-enriched diets for calving heifers in the periparturient period increase milk yield and improve blood metabolite profile. *Journal of Animal and Feed Sciences*. 14(1):259-262. <https://doi.org/10.22358/jafs/70533/2005>
- Kant S, and Yadav RK (2016). Effects of steaming up upon milk production and reproductive performance in crossbreed cows. *Agriways*, (2):138-144. <http://agriwaysjournal.com/wp-content/uploads/journals/volume4.2/4.pdf>
- Manosalva DG, Grispoldi L, Spagnolo M, and Crociati M (2022). Delayed first milking in unassisted overnight calving did not affect the quality of colostrum but influenced serum brix refractometry in Holstein calves at two days of life. *Animals*, 12 1665. <https://doi.org/10.3390/ani12131665>
- Nugraha P and Surjowardojo P (2022). Effect of steaming up on old pregnant parent weights, calf birth weight and colostrum production in PFH cattle in sumber rejeki group, Princi, Dau, Malang District. *Bantara Journal of Animal Science*, 4(2):52-60. <https://doi.org/10.32585/bjas.v4i2.2825>
- Playford RJ and Weiser MJ (2021). Bovine colostrum: its constituents and uses. *Nutrients*, 13(1):265. <https://doi.org/10.3390/nu13010265>
- Pradhan SM, Khanal B, and Hamal N (2011). Effect of steaming up practice in late pregnant stage in dairy cows. *Proceedings of the 8th National Workshop on Livestock and Fisheries Research*, 5(8):241-244.
- Putri Z and Surjowardojo P (2022). Differences of colostrum production in fore and rear teat of FHC dairy cow. *Jurnal Ternak*, 13(2):53-57. <https://doi.org/10.30736/jt.v13i2.151>
- Quinn EM, O'Callaghan TF, Tobin JT, Murphy JP, Sugrue K, Slaterry H, et al. (2020). Changes to the oligosaccharide profile of bovine milk at the onset of lactation. *Dairy*, 1(3):284-296. <https://doi.org/10.3390/dairy1030019>
- Sembada P (2018). Transformation of dairy production systems in Indonesia: assessing sustainability and long term trajectories of farms, Doctoral dissertation, Montpellier SupAgro, Spécialité: EFSA - Écologie Fonctionnelle et Sciences Agronomiques Discipline: Sciences Agronomiques, Rabat. <https://theses.hal.science/tel-02159387/>
- Sirohi AS, Patel AK, Mathur BK, Misra AK, and Singh M (2014). Effects of steaming-up on the performance of grazing does and their kids in arid region. *Indian Journal of Animal Research*, 48(1):71-74. <https://www.indianjournals.com/ijor.aspx?target=ijor:ijar1andvolume=48andissue=1andarticle=015>
- Soufleri A, Banos G, Panousis N, Fletouris D, Arsenos G, Kougioumtzis A, and Valergakis GE (2021). Evaluation of factors affecting colostrum quality and quantity in holstein dairy cattle. *Animals*, 11 2005. <https://doi.org/10.3390/ani11072005c>
- Statistics Indonesia. 2023. Fresh milk production by province. Accessed March 30th, 2023. <https://www.bps.go.id/indicator/24/493/1/produksi-susu-segar-menurut%20provinsi.htmlr>
- Surjowardojo P, Muarifah H, Rifa'i, and Handayani IM (2022). Colostrum quality of friesian holstein (FH) cow with different age of colostrum based on fat content. *Agriovet Journal*, 5(1):125-132. <https://doi.org/10.51158/agriovet.v5i1>
- Surjowardojo P, Noegroho VAK, Syahputra FT, and Yulinasari AP (2020). Colostrum quality of friesian holstein crossbreed from different milking day. *IOP Conference Series: Earth and Environmental Science*, 478: 012071. <https://doi.org/10.1088/1755-1315/478/1/012071>
- Surjowardojo P, Susilorini TE, and Rifa'i (2021). Production colostrum of dairy cows Friesian Holstein (FH) in different lactation periods. *Agriovet Journal*, 4(1):31-36. <https://doi.org/10.51158/agriovet.v4i1>
- Susilorini TE, Surjowardojo P, Sikone HY, Wardhana AC, and Rifa'i (2023). The performance of IgM colostrum of Friesian Holstein dairy cows at different lactation periods. *International Journal of Veterinary Science*, 12(1):136-138. <https://doi.org/10.47278/journal.ijvs/2022.158>